RESEARCH THE INFLUENCE OF TECHNICAL CONDITION OF THE INTAKE AIR FILTER ON FUEL CONSUMPTION

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Abstract: *It is known that fuel consumption is a diagnostic parameter, which gives sufficient, reliable information about the general technical condition of internal combustion engines. As on fuel consumption affect a large number of factors determining the extent of influence of these factors on fuel consumption is important. One of these factors is the condition of air filter.*

Keywords: POLLUTED AIR FILTERS, FUEL CONSUMPTION

1. Introduction

It is known that fuel consumption is a diagnostic parameter, which gives sufficient, reliable information about the general technical condition of internal combustion engines. As, on fuel consumption affect a large number of factors associated with both design features of engines, and a number of failures of their components and subsystems, determining the extent of influence of these factors on fuel consumption is important. Knowing their relative influence to this diagnostic parameter, it can be possible to determine the effectiveness of diagnosis of individual subsystems and develops optimal algorithms for diagnostic. Furthermore, this diagnostic parameter is essential because in practice already is used for monitoring and preventive diagnostics of mobile agricultural machinery and motor transport. This is achieved by modern information and communication technologies embedded in mobile machines. Through GPS and GPRS technologies, which send a large package of information that is stored and subsequently analyzed, is possible to develop maintenance strategies based on the results.

One of these factors is the condition of air filter.

According to [2, 3, 4] polluted air filter affects on fuel consumption depending on engine's fuel system, particularly presence or absence of an electronic control for the fuel injection system. If there is an electronic control it seen that there is no significant change in fuel consumption but power reduction in the engine. As, it is known there are wide varieties of mobile machines used in agriculture which are significantly different in their design features, firm origin, as well as their age. Therefore, it is necessary to use differentiated approach to obtain the necessary information, in order to develop rational organizational and technological approaches for diagnosis.

The goal of this research was to determine the rate of influence of polluted air filter on the fuel consumption for diesel engines with power 45kW.

To determine the fuel consumption at different levels of pollution in the air filter, was carried a research in laboratory conditions on engine with power 45kW. Fuel consumption was measured using volumetric method by flowmeter for liquid fuels type FLF-2 [1] (fig. 1), which was mounted at the fuel system of the engine (fig. 2).

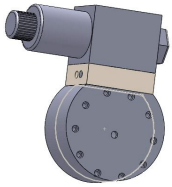

Fig.1 *Flowmeter for liquid fuels type FLF-2.*

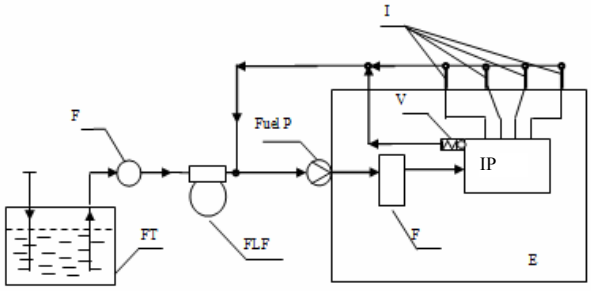

Fig.2 *Diagram of fuel system of engine D-65H with flowmeter FLF-2: FT – fuel tank; F – fuel filter; FLF – flowmetter for liquid fuels; Fuel P – fuel pump; E – diesel engine; IP – injector pump; V – valve; I – injections.*

Mounted in this way the flowmeter worked of vacuum and the returned fuel from injector pump and injectors was connected in the point located between the flowmeter and fuel pump. To avoid accumulation of air in this area was necessary to ensure complete fuel system airtight.

Different pollution of the air filter was simulated by throttling the air flow in air cleaning system and the vacuum was measured by vacuum meter mounted after the throttle valve (fig.3).

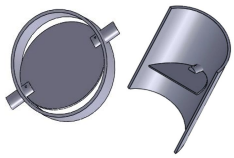

Fig.3 *Throttle valve.*

Based on the readings of the vacuum meter (bar) was determined the degree of pollution of the air filter (%). Maximum dilution was determined based on the moment when the engine stops working. On table 1 is shown the functional relationship between the degree of vacuum after the throttle and the pollution of the filter in percentage.

Table 1: *Readings of the vacuum meter and respectively degree of pollution of the filter.*

Vacuum meter readings, bar	Pollution of air filter, %
0,1	0
0,2	25
0,3	50
0,4	75
0,5	100

2. Statistical Analysis

The obtained results of the research were processed by the software product "STATISTICA" to determine the type of functional relationship, (linear or higher), between the input factors and output parameters and their confidence interval.

At fig.2 is shown the regression line and confidence interval for linear model and at fig.3 for polynomial model of relationship, where "x" is engine's power in kW, and "y" is the fuel consumption in l/h.

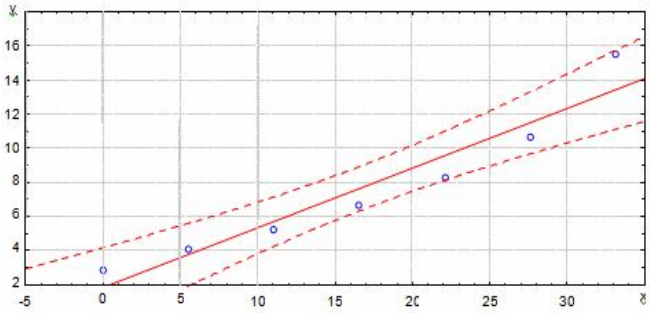

Fig.2 *Regression line and confidence interval for linear model.*

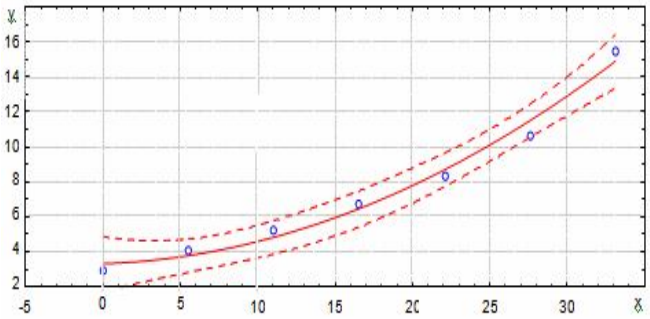

Fig.3 *Regression line and confidence interval for polynomial model.*

The figures show that in both models in confidence interval (confidence probability γ=0.95) are all experimental data, but for polynomial model the confidence interval is narrower and the regression line passes closer to the experimental points. Therefore the fuel consumption is described accurately by the polynomial model.

3. Results of Experimental Research

Fig.3 shows the results of experimental research about changes the fuel consumption depending on the pollution of the air filter.

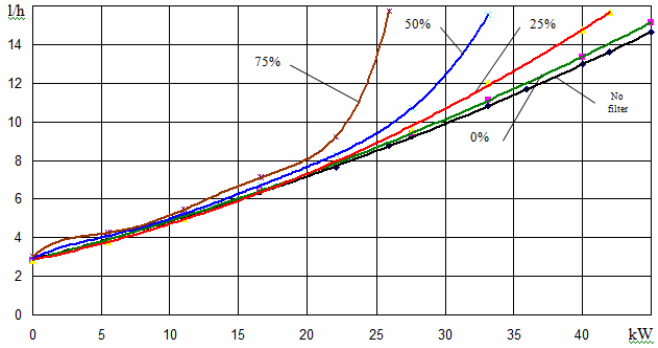

Fig.3 *Fuel consumption depending on the pollution of the air filter.*

The figure shows that polluted air filter has a significant affect on fuel consumption and engine's power. Increased pollution by 25% reduces the maximum power to 6.7% and increases fuel consumption to 15%. Pollution at 50% and 75%, decreases power respectively to 26% and 42% and increases fuel consumption respectively to 44% and 80%.

When performing an agricultural operation as plowing of 0,20m depth of working with an agricultural unit (plow PN- 2-30), which requires 25 kW engine's power, 25% and 50% pollution of the air filter increases fuel consumption respectively to 4% and 14%.

4. Conclusions

1. Pollution of the air filter has a significant affect on fuel consumption and engine's power.

2. It is not economically profitable to use 75% or above polluted, of its resources, air filter as significantly affect to engine performance.

5. References

[1] Behched B., T. Delikostov, N. Stancheva, P. Petrov. Substantiate And Research Of The Characteristics A Flowmeter For Fuel Consumption. trans&MOTAUTO'08, p. 49-51.

[2] Shean Huff, Kevin Norman, Brian West. Effect of Intake Air Filter Condition on Vehicle Fuel Economy. 2009. http://www.osti.gov/bridge/product.biblio.jsp?query_id=4&page=0&osti_id=948545&Row=0

[3] Стоянов Калоян, Христо Белоев. Изследване влиянието на степента на замърсеност на въздушния филтър върху разхода на гориво при земеделските агрегати. МЗ-2007.

[4] Христов Р., Изследване влиянието на въздушното отношение върху скоростта на горене и разпространението на пламъка в опитна горивна камера с постоянен обем, Тринадесета научно-техническа конференция с международно участие „Транспорт, екология – устойчиво развитие" Варна 2007, ISBN 954-20-00030, стр.798-803.

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